(19) World Intellectual Property Organization International Bureau



(43) International Publication Date 3 November 2005 (03.11.2005)

PCT

(10) International Publication Number WO 2005/104251 A1

| (51) | International Patent 21/205 | t Classif | ication ⁷ : | H01L 33 | 6/00 , |
|------|--|-----------|------------------------|---------------|---------------|
| (21) | International Appli | cation l | | T/JP2005/008 | 3461 |
| (22) | International Filing | Date: | 27 April 2 | 2005 (27.04.2 | 005) |
| (25) | Filing Language: | | | Eng | glish |
| (26) | Publication Langua | ge: | | Eng | glish |
| (30) | Priority Data: | | | | |
| | 2004-131617 | 27 A | April 2004 (| 27.04.2004) | JР |
| | 60/570,135 | 12 N | May 2004 (1 | 2.05.2004) | US |
| | 2004-153709 | 24 | May 2004 (| 24.05.2004) | ЛР |
| | 2004-165406 | 3 | June 2004 (| 03.06.2004) | JP |
| | 2004-193744 | | • | 30.06.2004) | JP |
| į | 60/585,919 | | • | 8.07.2004) | US |
| | 2004-213423 | 21 | July 2004 (| 21.07.2004) | JP |
| | 2005-031374 | 8 Febr | uary 2005 (| 08.02.2005) | JP |
| (71) | Applicant (for all designated States except US): SHOWA | | | | |
| | DENKO K.K. [JP/JP]; 13-9, Shibadaimon 1-chome, Mi- | | | | |

nato-ku, Tokyo, 1058518 (JP).

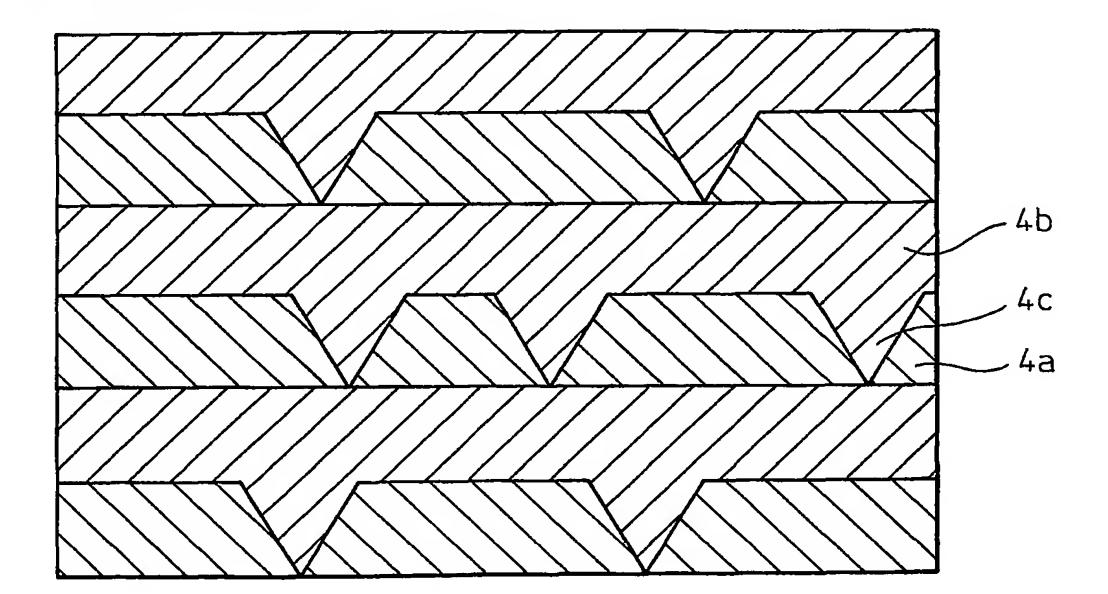
(72) Inventors; and (75) Inventors/Applicants (for US only): BANDOH, Akira [JP/JP]; c/o SHOWA DENKO K.K., 5-1, Yawata Kaigan dori, Ichihara-shi, Chiba, 2900067 (JP). SAKAI, HIromitsu [JP/JP]; c/o SHOWA DENKO K.K., 5-1, Yawata Kaigan dori, Ichihara-shi, Chiba, 2900067 (JP). KOBAYAKAWA, Masato [JP/JP]; c/o SHOWA DENKO K.K., 5-1, Yawata Kaigan dori, Ichihara-shi, Chiba, 2900067 (JP). OKUYAMA, Mineo [JP/JP]; c/o SHOWA DENKO K.K., 5-1, Yawata Kaigan dori, Ichihara-shi, Chiba, 2900067 (JP). TOMOZAWA, Hideki [JP/JP]; c/o SHOWA DENKO K.K., 5-1, Yawata Kaigan dori, Ichihara-shi, Chiba, 2900067 (JP). MIKI, Hisayuki [JP/JP]; c/o SHOWA DENKO K.K., 5-1, Yawata Kaigan dori, Ichihara-shi, Chiba, 2900067 (JP). GAZE, Joseph [GH/JP]; c/o SHOWA DENKO K.K., 5-1, Yawata Kaigan dori, Ichihara-shi, Chiba, 2900067 (JP). HORIKAWA, Syunji [JP/JP]; c/o SHOWA DENKO K.K., 13-9, Shibadaimon 1-chome, Minato-ku, Tokyo, 1058515 (JP). SAKURAI,

Tetsuo [JP/JP]; c/o SHOWA DENKO K.K., 5-1, Yawata

Kaigan dori, Ichihara-shi, Chiba, 2900067 (JP).

[Continued on next page]

(54) Title: N-TYPE GROUP I I I NITRIDE SEMICONDUCTOR LAYERED STRUCTURE



(57) Abstract: An object of the present invention is to provide a low-resistance n-type Group III nitride semiconductor layered structure having excellent flatness and few pits. The inventive n-type group III nitride semiconductor layered structure comprises a substrate and, stacked on the substrate, an n-type impurity concentration periodic variation layer comprising an n-type impurity atom higher concentration layer and an n-type impurity atom lower concentration layer, said lower concentration layer being stacked on said higher concentration layer.

- (74) Agents: AOKI, Atsushi et al.; A. AOKI, ISHIDA & ASSOCIATES, Toranomon 37 Mori Bldg., 5-1, Toranomon 3-chome, Minato-ku, Tokyo 105-8423 (JP).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH,

GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.